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(54) Tractor and implement combination, and hitch adapter therefor.

(57) An implement (12) is connected through its towing tongue (25) to a tractor (10) by way of an upright transmission (43) and a coupler which comprises a hitch bracket (28) and hitch adapter (80). In order to avoid the transmission (43) having to withstand the towing forces, the transmission (43) is supported entirely by the tongue (25), and the coupler (28, 80) is connected to the tractor (10) and tongue (25) exclusively of the transmission (43). In this way the towing forces by-pass the transmission (43) and are transmitted by the coupler (28, 80). This means that the transmission (43) can be less robust and therefore can be made cheaper.

The transmission (43) can comprise two identical right angle gear boxes (46, 52) of which the lower box (52) is turned to maintain alignment by a steering arm (102) connected to the hitch adapter (80) as the tractor (10) turns.

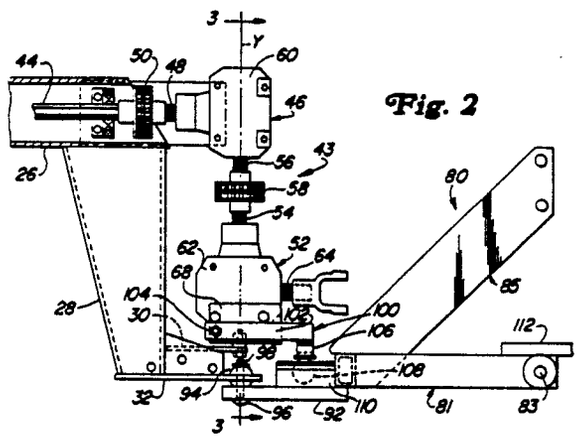

Fig. 2

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Tractor and implement combination, and hitch adapter therefor

This invention relates to a tractor and implement with a towing tongue for being drawn by the tractor having apparatus, for transmitting power from the tractor to the implement and for attaching the implement to the tractor, comprising an upright transmission connected between the forward end portion of the tongue and the tractor, and a coupler which couples the tongue to the tractor.

Such apparatus has been proposed in EP-A-0 027 295 in which a vertical transmission carrying power from a tractor to an implement has an upper part supported from a tongue of the implement and a lower part supported by a hitch of the tractor. Thus power and drawing forces are transmitted to the implement through the transmission.

This means that the transmission must be sufficiently strong to sustain the large forces involved.

The present invention enables the forces on the transmission to be reduced and therefore the transmission to be simpler and to be made more cheaply.

According to the invention the transmission is supported only by the tongue, and the coupler is connected to the tractor and implement exclusively of the transmission so that drawing forces are transmitted substantially through the coupler rather than the transmission.

By supporting the transmission solely on the tongue, and by providing a separate coupler to hitch the implement to the tractor it is ensured that the drawing forces will not pass through the transmission but rather through the coupler. Thus the loading on the transmission is reduced and it need not fulfill the exacting requirements of strength. Hence it can be of simpler and less expensive construction.

Desirably the coupler comprises a hitch frame secured to the tongue, a hitch adapter connected to the tractor and a joint connecting the hitch adapter and hitch frame.

The hitch adapter can comprise a horinzontal U-shaped frame, outwardly projecting lower hitch pins on the legs of the U-shaped frame, a mast rigid with the U-shaped frame and extending upwardly therefrom, and an upper hitch pin on the upper end of the mast. The invention includes such a hitch adapter per se.

Embodiments of the invention will now be described with reference to the accompanying diagramnatic drawings in which:

Fig. 1 is a right side elevational view of an implement coupled to the three-pont hitch and power take-off shaft of a towing tractor by a coupler and transmission assembly;

Fig. 2 is an enlarged right side elevational view of the coupler and transmission assembly at the forward end of a tongue of the implement shown in Fig. 1 with the tongue beam being broken away to expose a portion of the transmission assembly;

Fig. 3 is an enlarged vertical sectional view taken along line 3--3 of Fig. 2 but with gear boxes of the transmission assembly omitted for clarity;

Fig. 4 is a right side elevational view of another embodiment of the coupler hitch adapter and transmission assembly; and

Fig. 5 is a vertical sectional view taken through the gear boxes of the transmission assembly shown in Fig. 4.

Referring now to Fig. 1, there is shown a tractor 10 coupled for towing and supplying power to an agricultural implement 12. Specifically, the tractor 10 includes a three-point hitch 14 having its upper and two lower links pivotally connected to a quick coupler 16. The tractor 10 also includes a rearwardly extending drawbar 18 and a power take-off shaft 20 located within a shield 22.

The implement 12 is here shown in the form of a mower conditioner comprising a body 23 supported on transversely spaced ground wheels 24 (only one shown) and having a tongue 25 projecting forwardly from the left side thereof. The tongue 25 comprises a box beam 26 and an L-shaped hitch frame or bracket 28 (Fig. 2) joined integrally with and depending from the beam 26 and including upper and lower, horizontally projecting support and hitch plates 30 and 32, respectively (see Fig. 2), having purposes described below. A support stand 34 is vertically pivotally connected, as by a pin 36, to a lower forward location of the bracket 28 for movement between a raised position, as shown in solid lines in Fig. 1, wherein the bracket 28 is partially received between opposite, transversely spaced stand sidewalls 38 (only one sidewall shown) and a lowered position, as shown in dashed line in Fig. 1, wherein a foot 40 joining the sidewalls 38 engages the ground. A latch pin 42 extends through aligned holes in the stand 34 and bracket 28 for selectively maintaining the stand in its raised position.

As can best be seen in Fig. 2, the implement 12 includes a power transmission assembly 43, for driving apparatus (not shown) of the implement, comprising a power shaft 44 rotatably supported in the beam 26, a first right angle gear box 46 having an output shaft 48 connected to the shaft 44 by a sprocket and chain type shaft coupler 50 and a second right angle gear box 52 having an output shaft 54 connected to an input shaft 56 of the first

gear box by a sprocket and chain type shaft coupler 58. Specifically, the first gear box 46 includes a housing 60 rigidly mounted on the forward end of the beam 26 and containing a pair of meshed bevel gears (not shown) respectively mounted on the shafts 48 and 56 in a manner well known in the art (e. g. see Fig. 5). The second gear box 52 includes a housing 62 containing another pair of meshed bevel gears (not shown) respectively mounted on the output shaft 54 and on an input shaft 64 projecting forwardly and connected to the tractor power take-off shaft 20 by a telescopic drive shaft 66 (see Fig. 1). The gear box housing 62 has a lower portion thereof received within and bolted to a channel bracket 68. The horizontal support plate 30 of the hitch bracket 28 extends beneath and parallel to a bottom of the bracket 68. The plate 30 is pivotally received on a bushing 72 which is located in alignment with the gear box shafts 54 and 56 and held in place by a bolt 74 extending through the bushing 72 and bracket 68 and carrying a washer 76 which acts, upon tightening a nut 78 on the bolt, to urge the bushing tightly against the bracket 68. Thus, the shaft coupler 58 and bushing 72 cooperate to support the second gear box 52 for swivelling about a vertical axis Y, during turning of the tractor 10, in a manner more fully described below.

A hitch adapter 80 connects the implement hitch bracket 28 to the quick coupler 16. The hitch bracket 28 and hitch adapter 80 together constitute a coupler for transmitting drawing forces from the tractor 10 to the implement 12. Specifically, the hitch adapter 80 includes a horizontal, U-shaped member 81 forming transversely spaced, forwardly extending legs 82 (only one shown), each supporting an outwardly projecting hitch pin 83 received in an upturned hook 84 of the quick coupler 16. Joined to and extending upwardly and forwardly from a central location of the member 81 is a mast member 85 defined by parallel spaced plates 86 supporting a cross pin 88 at the forward end thereof, the pin 88 being engaged by a central hook member 90 of the quick coupler. Joined to and extending horizontally and rearwardly from a central location of the U-shaped member 82 is a hitch bar 92. A ball coupler 94 is carried by the horizontal hitch plate 32 of the implement hitch bracket 28 and is centred on the axis Y. A hitch pin 96 extends through the hitch bar 92 and ball coupler 94 and is held in place by a pin 98 received in a hole provided in the pin 96. Thus, it will be appreciated that as the implement transverses uneven ground the implement will be permitted to undergo universal movement about the ball coupler 94 and, as the tractor turns, articulation will take place about the axis Y. Provided for preventing turning loads and drive torque reaction loads from being imposed on the telescopic drive shaft 66 is a steering or torque arm 100 comprising a pair of spaced straps 102 having their rear ends coupled to a rear portion of the channel bracket 68 by a horizontal pivot pin 104 and having their forward ends projecting forwardly beyond the bracket 68 and interconnected by a ball support member 106 having a downwardly projecting ball 108 fixed thereto. Fixed to the top of the hitch adapter hitch bar 92 is a fore-and-aft extending, upwardly opening guide track 110 which in vertical transverse cross-section (Fig. 3) is shaped complimentarily to the ball 108, with the latter being received in the track. Thus, turning motion of the tractor 10 relative to the implement will occur about the axis Y and be transferred to the second right angle gear box 52 by the arm 100 so as to maintain the input shaft 64 of the gear box 52 in alignment with the tractor power take-off shaft 20. Also any tendency of drive torque reactions to rotate the gear box 52 about the axis Y will be restrained by the arm 100. Also, it can be seen that the ball 108 will roll in the track 110 when the implement rolls about the ball coupler 94 and will shift fore-and-aft in the track when the implement pitches about the coupler. The horizontal alignment of the power take-off shaft 20 and gear box input shaft 64 is maintained during operation by a downstop 112 in the form of a bar fixed to one of the legs of the hitch adapter 80 and having a downwardly projecting forward end 114 engaged with the tractor drawbar 18. Thus, the downstop operates to prevent the three-point hitch 14 from lowering to the extent that there is a significant difference between the heights of the power take-off shaft 20 and input shaft 64 which would result in significant additional drive loads being imposed on the telescopic drive shaft 66. However, the shaft 66 will telescope to accommodate small differences in heights as might result from using different towing tractors.

The operation of the embodiment illustrated in Figs 1 - 3 can be understood from the foregoing description and for the sake of brevity is not reiterated here. However, it is to be noted that due to the fact that the hitch adapter 80 is structurally separate from the power transmission assembly, the hitch adapter is not captive to being used with the implement 12 but may easily be unhitched therefrom and used with a different implement. Also, economies are realized by using common identical right angle gear boxes 46 and 52 in the power transmission assembly 43.

Referring now to Figs 4 and 5, there is shown a second embodiment of the invention which in principle is quite similar to the embodiment of Figs 1 - 3. Specifically, shown is a forward end portion of an implement tongue 120 including a box beam 122 having an L-shaped hitch bracket 124 fixed to

and depending from an undersurface thereof. The bottom of the bracket 124 is defined by a horizontal hitch plate 126 in which is incorporated a ball coupler 128.

A power transmission assembly 130 is provided for driving apparatus (not shown) of the implement and includes a power shaft 131 mounted below and in parallel relationship to the box beam 122 by shaft support hangers (not shown). Mounted to a lower front surface of the beam 122 is a first right angle gear box 132 including a housing 134 defined in part by removable rear and bottom shaft support walls 136 and 138, respectively, and an interior shaft support core 140. An output shaft 142 is rotatably supported in the rear wall 136 and core 140 by bearings 144 and 146, respectively, and is coupled to the power shaft 131 by a sprocket and chain type shaft coupler 147. A shaft 148 is rotatably supported in the bottom wall 138 and core 140 by bearings 150 and 152 respectively. A first set of meshed right angle bevel gears 154 and 156 are respectively mounted to the shafts 142 and 148. Located beneath the gear box 132 is an identical second gear box 158 including a housing 160 defined in part by removable upper and front shaft support walls 162 and 164, respectively, and an interior shaft support core 166. The shaft 148 serves both as the input to the gear box 132 and as the output shaft of and as the sole support for the gear box 158 and is rotatably supported in the upper wall 162 and core 166 by bearings 168 and 170, respectively. An input shaft 172 is rotatably supported in the front wall 164 and core 166 by bearings 174 and 176, respectively, and is adapted for connection to the power take-off shaft of a towing tractor. A second set of meshed right angle bevel gears 178 and 180 are respectively mounted on the shaft 148 and the input shaft 172. It is noted that the shaft 148 is vertical and lies on an axis W which passes through the ball coupler 128.

A hitch adapter 182 is provided for mounting the hitch bracket 124 of the tongue 120 to the three-point hitch of a towing tractor. The adapter 182 includes a horizontal U-shaped frame member 184 having opposite transversely spaced legs 192 having lower ends fixed to the legs 186 of the frame member 184 and having upper ends joined by a cross member 194 carrying a bracket 196 supporting a cross pin 198. The two hitch pins 189 and cross pin 198 either cooperate for connection to three points of a quick coupler, like that described above, or may serve for direct coupling to the lower and upper links of the tractor three-point hitch. Fixed to a central bottom surface of the transverse portion 188 of the U-shaped frame member 184 is a horizontal hitch bar 200 carrying a vertical pin 202 received in the ball coupler 128 and held in place by a key or clip (not shown) inserted in a hole 204 provided in the pin. Thus, it will be appreciated that during turning of a towing tractor the hitch adapter 182 will pivot relative to the implement about the axis W. For the purpose of causing the gear box 158 to move about the axis W so as to maintain the input shaft 172 aligned with the tractor power take-off shaft a steering or torque arm 206 is fixed to the bottom of and projects forwardly from the housing. The arm 206 has a downwardly projecting forward end 208 having a roller 210 mounted thereto for rotation about a horizontal axis and received for restrained up and down movement within a vertical guide track 212 fixed to a central vertical inner face of the transverse adapter portion 188. A downstop 214, like the previously described downstop 112, is fixed to and projects forwardly beyond one of the adapter legs 186 and has a downturned end 216 adapted for engaging a towing tractor drawbar for positioning the hitch adapter 182 for holding the implement tongue at a desired level for disposing the input shaft 172 of the gear box 158 at substantially the same height as the power take-off shaft of a towing tractor.

Thus, it will be appreciated that one of the main differences between the embodiment illustrated in Figs 4 and 5 and that illustrated in Figs 1 - 3 is that the gear boxes 132 and 158 share the shaft 148 which serves also as the sole support for the lower gear box 158. Another main difference is that the steering arm 206 is fixed rather than pivoted to the lower gear box, carries a roller 210 rather than a ball with the roller 210 being received in a vertical guide track 212 rather than a horizontal track. Despite these differences, it will be appreciated that the gear box 158 is mounted for pivoting about a vertical axis and that the arm 206 operates to transfer to the hitch adapter torque reaction forces tending to rotate the gear box about the axis W and operates in response to the pivotal movement of the hitch adapter 182 about the axis W, to pivot the gear box 158 about the axis W.

The hitch adapter and transmission assembly of either embodiment are of relatively simple and inexpensive construction and cooperate to permit a towing tractor to turn sharply.

Claims

1. A tractor and implement with a towing tongue for being drawn by the tractor having apparatus, for transmitting power from the tractor (10) to the implement (12) and for attaching the implement (12) to the tractor (10), comprising an upright transmission (43, 130) connected between the forward end portion of the tongue (25, 120) and the tractor (10), and a coupler (28, 80, 124, 182)

which couples the tongue (25, 120) to the tractor (10) characterised in that the transmission (43, 130) is supported only by the tongue (25, 120), and the coupler (28, 80, 124, 182) is connected to the tractor (10) and implement (12) exclusively of the transmission (43, 130) so that drawing forces are transmitted substantially through the coupler (28, 80, 124, 182) rather than the transmission (43, 130).

2. A tractor and implement combination according to claim 1 characterised in that the coupler (28, 80, 124, 182) comprises a hitch frame (28, 124) secured to the tongue (25, 120), a hitch adapter (80, 182) connected to the tractor (10) and a joint (94, 128) connecting the hitch adapter (80, 182) and hitch frame (28, 124).

3. A tractor and implement combination according to claims 1 or 2 characterised in that the transmission (43, 130) comprises an upper gear box (46, 132) power-connected to the implement and a lower gear box (52, 158) power-connected to the tractor (10), the gear boxes (46, 132, 52, 158) being relatively rotatable about a comnon upright axis (Y, W).

4. A tractor and implement combination according to claims 2 and 3 characterised in that the said joint (94, 128) is disposed on the upright axis (Y, W) below the lower gear box (52, 158).

5. A tractor and implement combination according to claims 2 and 3 or claims 2 and 4 characterised in that the transmission (43, 130) includes a steering arm (100, 206) guided by the hitch adapter (80, 182) to turn the lower gear box (52, 158) about the common upright axis (Y, W) so as to maintain alignment between the lower gear box (52, 158) and tractor (10) as the tractor (10) and hitch adapter (80, 182) turn relative to the implement (12).

6. A tractor and implement combination according to claim 5 characterised in that the steering arm (100) is pivotally connected at its rearward end to the lower gear box (52) for upward and downward swinging movement and at its forward end, via a ball (108) and a fore-and-aft guide track (110), to the hitch adapter (80).

7. A tractor and implement combination according to claim 5 characterised in that the steering arm (206) is rigidly connected at its rearward end to the lower gear box (158) and at its forward end, via a roller (210) in an upwardly extending guide track (212), to the hitch adapter (182).

8. A tractor and implement combination according to any of claims 3 to 7 characterised in that the upper and lower gear boxes (46, 132, 52, 158) are substantially identical.

9. A tractor and implement combination according to any of claims 3 to 8 characterised in that the gear boxes (132, 158) are interconnected by a single shaft (148) acting as output shaft of the lower gear box (158) and input shaft of the upper gear box (132), the single shaft (148) supporting the lower gear box (158) from the upper gear box (132).

10. A tractor and implement combination according to any of claims 2 to 9 characterised in that the hitch adapter (80, 182) includes a downstop (112, 214) engaging a drawbar (18) of the tractor (10).

11. A tractor and implement combination according to any of claims 2 to 10 characterised in that the hitch adapter (80, 182) comprises a horizontal U-shaped frame (81, 184), outwardly projecting lower hitch pins (83, 189) on the legs of the U-shaped frame (81, 184), a mast (85, 190) rigid with the U-shaped frame (81, 184) and extending upwardly therefrom, and an upper hitch pin (88, 198) on the upper end of the mast (85, 190).

12. A tractor and implement combination according to claim 11 characterised in that the hitch adapter (80, 182) includes a hitch bar (92, 200) rigid with the U-shaped frame (81, 186) extending rearwardly therefrom, the hitch bar (92, 200) being connected to the hitch frame (28, 124) through the said joint (94, 128).

13. A tractor and implement combination according to claims 7 and 12 characterised in that the guide track (212) is fixed to the top of the hitch bar (92).

14. A tractor and implement combination according to claim 2 or to claim 2 and any of claims 3 to 13 characterised in that a support stand (34) is pivotally connected to the hitch frame (28, 124) for upward and downward swinging movement between a raised inoperative storage position and a lowered operative position in which it engages the ground to support the implement (12).

15. A tractor and implement combination according to claim 2 or to claim 2 and any of claims 3 to 14 characterised in that the said joint is a ball joint (94, 128).

16. A hitch adapter (80, 182) for a tractor and implement combination characterised in that the hitch adapter (80, 182) has the features of the adapter in any of claims 11, 12 or 13.

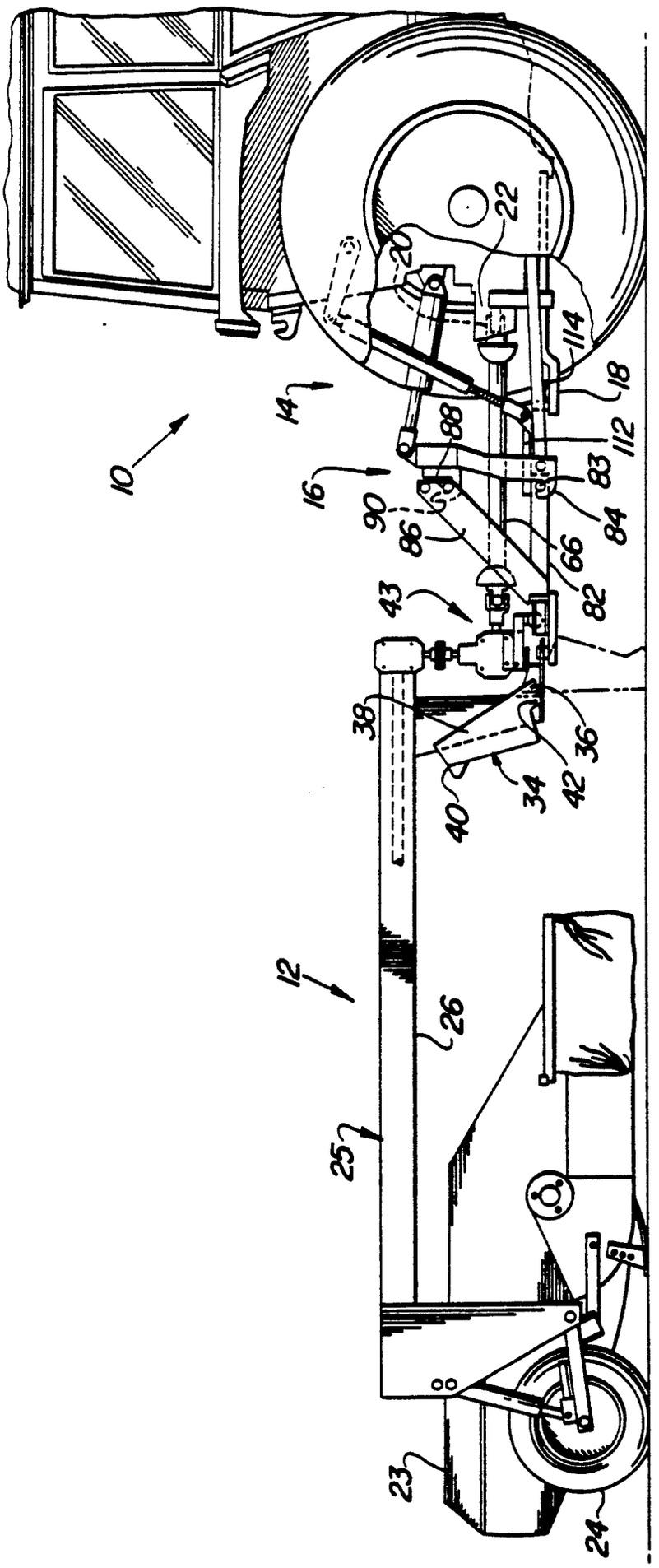
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Fig. 1

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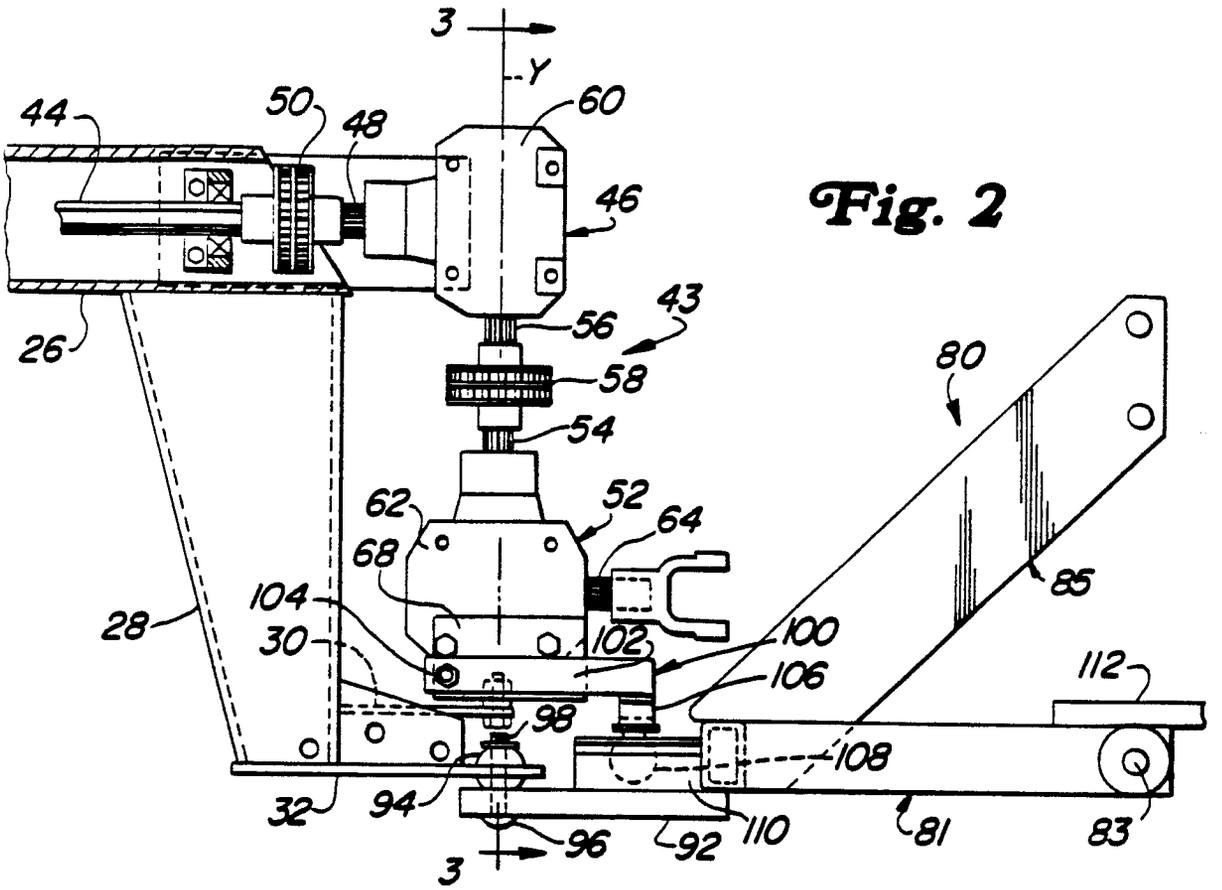

Fig. 2

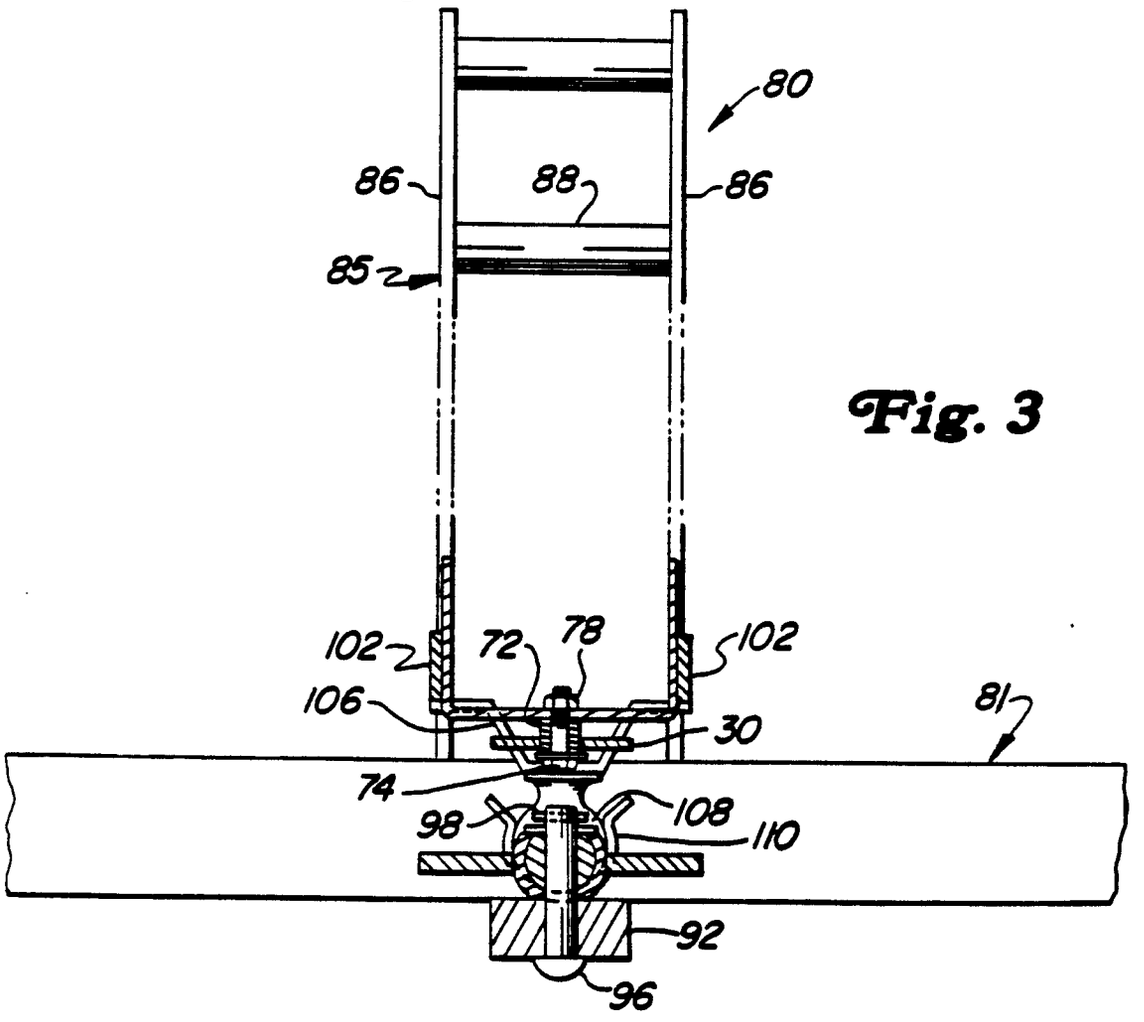

Fig. 3

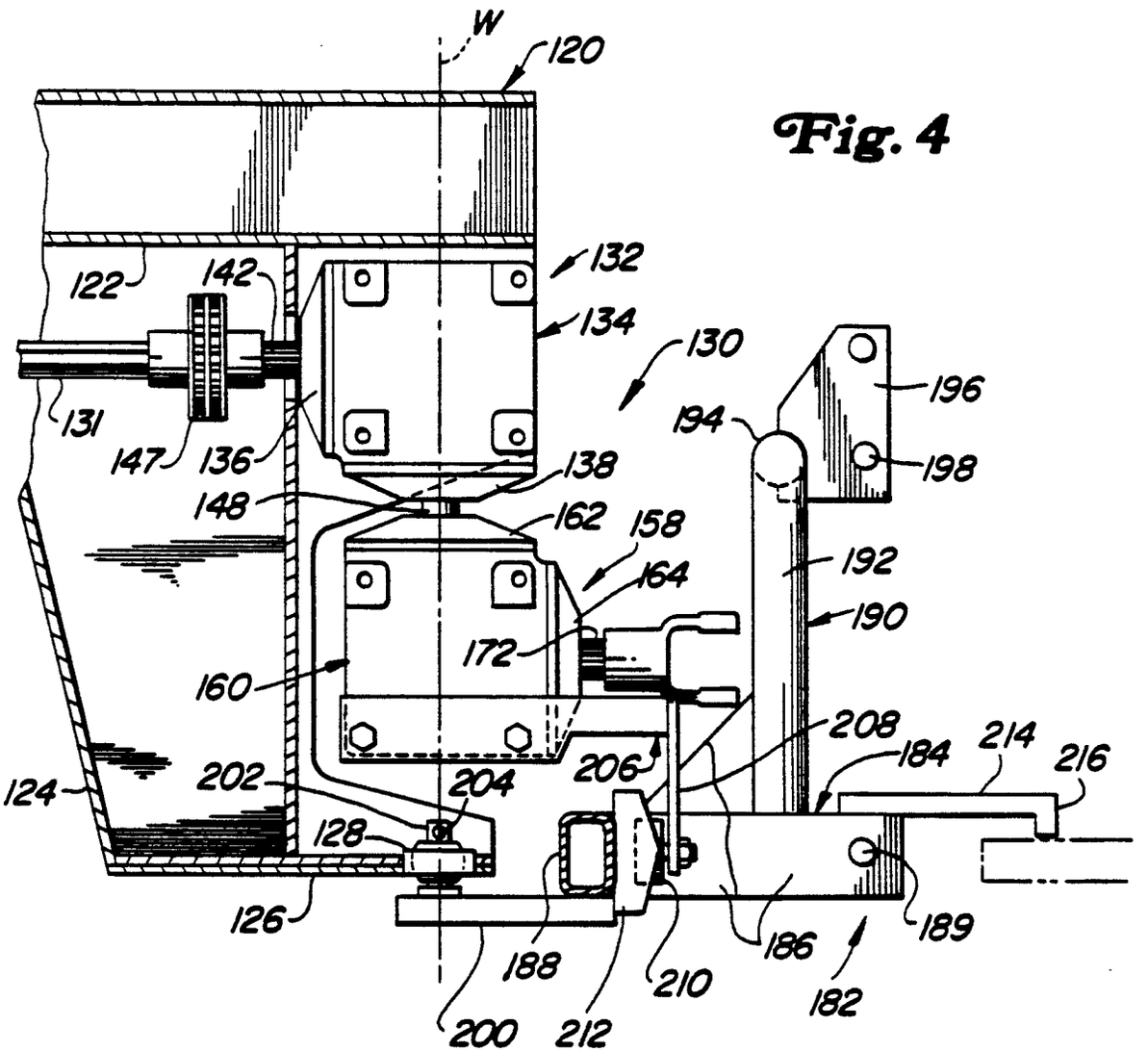
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Fig. 4

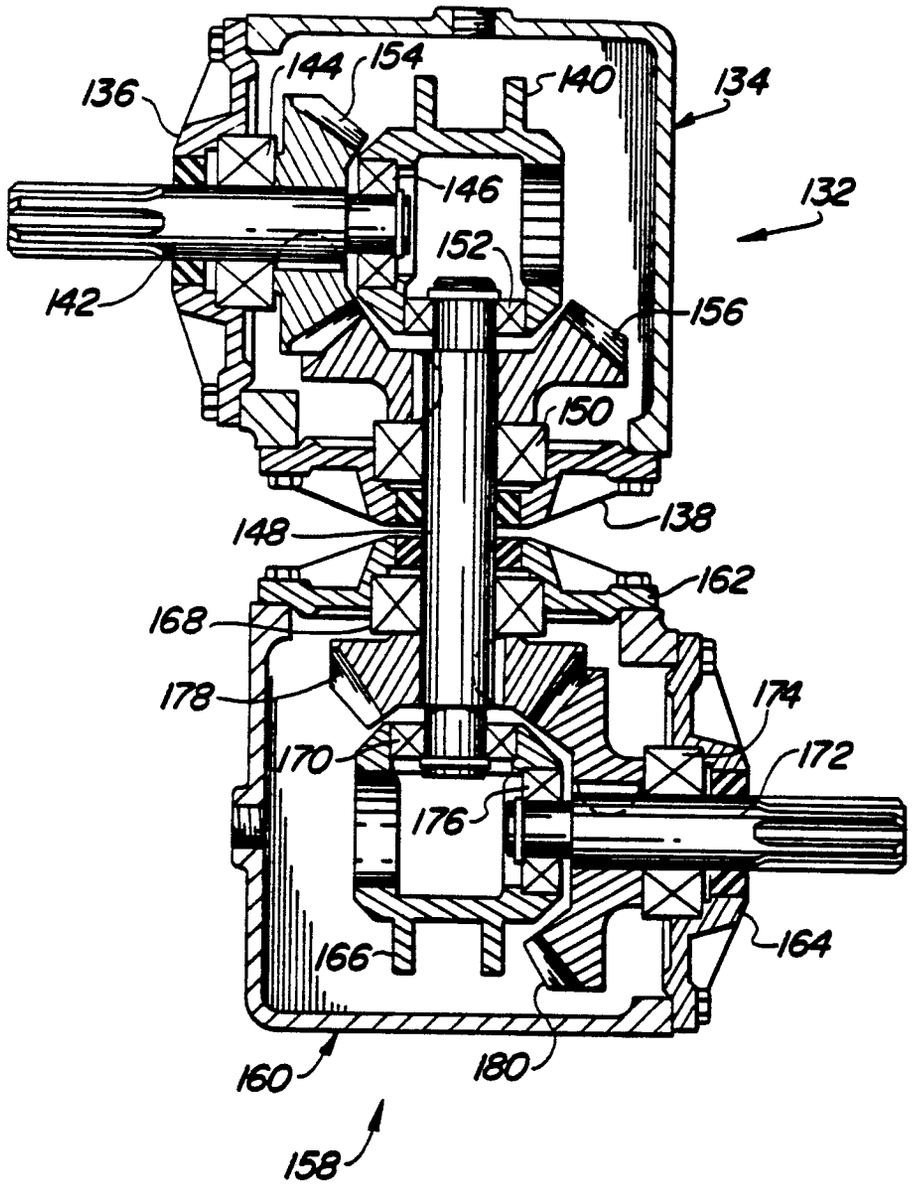
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Fig. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 87 11 6265

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
A,D	EP-A-0 027 295 (MULTINORM) * Abstract; figures 1-8 *	1	A 01 B 71/06
A	EP-A-0 124 462 (KUHN)		
A	EP-A-0 196 263 (KUHN)		
A	GB-A-1 128 958 (MASSEY-FERGUSON)		
A	DE-A-3 411 672 (PÜRRER)		

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

A 01 B
A 01 D
F 16 H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15-02-1988	VON ARX V.U.

CATEGORY OF CITED DOCUMENTS

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